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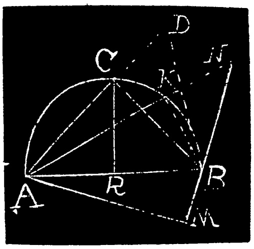
104. Proposed by SAMUEL E. HARWOOD, M. A., Professor of Mathematics, Southern Illinois State Normal University, Carbondale, Ill.

To find a point in a semi-circumference such that the sum of its distances from the extremities of the diameter shall be a maximum. [From *Wentworth's Plane Geometry*, Ex. 387.]

I. Solution by J. F. COWAN, Carbondale, Ill.

Through C, the middle point of the semi-circumference, draw AD, making $CD=CA=CB$. Then BD is perpendicular to AB. Ex. 46, Wentworth.

Through K, any other point in the semi-circumference, draw AN, making $KN=KB$.



Draw NB, producing it to meet AM at right angles.

$\angle ACB = \angle CBD + \angle CDB$.

Exterior angle of triangle BCD.

$\angle AKB = \angle KNB + \angle KBN$.

Exterior angle of triangle KBN.

$\angle ACB = \angle AKB$.

Right triangles.

Triangles CDB and KNB are isosceles.

By construction.

$\therefore \angle CDB = \angle KNB$. $\therefore \triangle ABD$ and $\triangle AMN$ are similar.

$AM < AB$. Base<hypotenuse of triangle.

$\therefore AN < AD$. Homologous lines of similar triangles.

$\therefore AK + KB < AC + CD$. C is the point. Q. E. F.

Mr. Cowan is a student of Southern Illinois State Normal University, and the above demonstration was sent to us by Prof. S. E. Harwood of the Department of Mathematics of that University.

A similar demonstration was given by *P. S. BERG*, *J. M. COLAW*, *H. F. STRATTON*, *WALTER H. DRANE*, *ALOIS F. KOVARIK*, and *ELMER SCHUYLER*.

II. Solution by J. O. MAHONEY, B.E., M. Sc., Master and Instructor in Mathematics and Science, Carthage Graded and High School, Carthage, Tex.; J. SCHEFFER, A. M., Hagerstown, Md.; CHARLES C. CROSS, Libertytown, Md.; P. S. BERG, B. Sc., Principal of Schools, Larimore, N. D.; G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

From the center R of the semi-circle ACB draw RC perpendicular to AB, then C is the point required.

Proof: ACB is the maximum inscribed triangle.

AKB is any other inscribed triangle.

$AC^2 + CB^2 = AK^2 + KB^2$.

$2AC.CB > 2AK.KB$.

$AC^2 + CB^2 + 2AC.CB > AK^2 + KB^2 + 2AK.KB$, or $AC + CB > AK + KB$.

III. Solution by F. W. BRADBURY, A. M., Head Master, Cambridge Latin School, Cambridge, Mass.

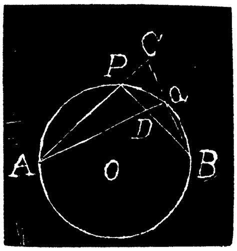
Let C be the middle point of the semi-circumference ACB, whose diameter is AB. Draw AC, BC; and CO perpendicular to AB. Then $AC + BC$ is a maximum. $AC > AO$, its projection on AB.

As the point C moves along the arc ACB, CO becomes less, and the line

AC becomes nearer equal to its projection on AB. Just so BC, when C is at A (or C) $AC+BC$=the sum of their projections on AB, or $AO+OB$.

That is, as C moves from the middle of the arc ACB, $AC+BC$ becomes less. $\therefore$ $AB+BC$ is a maximum when C is at the middle of the arc ACB.

IV. **Solution by B. F. YANNEY, A. M., Professor of Mathematics, Mount Union College, Alliance, Ohio.**



The required point is the mid-point of the semi-circumference.

Proof. Let Q be any other point in the semi-circumference than point P.

Produce AP and BQ until they meet, as at C.

Now $\triangle APD = \triangle BPC$, each being a right triangle, and having a leg and an acute angle of the one=to a leg and a homologous acute acute of the other.

$\therefore PC=PD$.

But $AC>AQ$, and $DB>QB$. Hence $AP+PD+DB>AQ+QB$, or $AP+PB>AQ+QB$. Q. E. D.

Other solutions were furnished by *NELSON L. RORAY*, *CHARLES C. CROSS*, *M. A. GRABER*, *J. M. COLAW*, and *COOPER D. SCHMITT*. Professors Cross, Colaw, and Yanney each furnished two solutions.

CALCULUS.

78. **Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.**

Investigate value of $\left(\frac{\tan x}{x}\right)^{1/x^n}$ where x is 0 and n has consecutive values 1, 2, 3, 4, ... Is there any law governing the different results? When $n=1$, result is 1; when $n=2$, result is $e^{\frac{1}{3}}$; $n=3$, gives ∞, etc.

II. **Solution by the PROPOSER.**

Let $y=\left(\frac{\tan x}{x}\right)^{1/x}$, making $n=1$, in the given expression.

Then $\log y=\frac{\log(\tan x/x)}{x}$ which is of the form 0/0.

$$\text{By the calculus this}=\frac{\frac{x\sec^2 x-\tan x}{x^2}}{\frac{\tan x}{x}}=\left.\frac{x\sec^2 x-\tan x}{x^2}\right]_{x=0} \text{since } \left.\frac{\tan x}{x}\right]_{x=0}=1.$$

The numerator of this expression is the fundamental form which will occur in all the different values given to n.

Continuing the evaluating process we have